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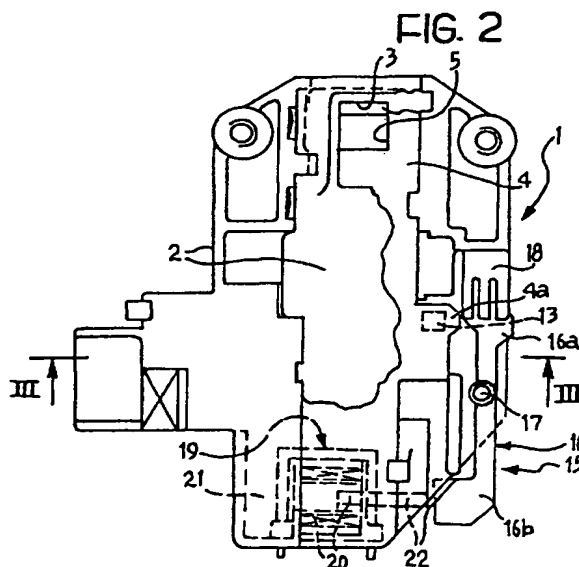
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## (54) A door locking device for an electric household appliance

(57) The device (1) includes a support casing (2), a retaining slider (4) mounted in the casing (2) for movement between a working position in which it holds a hook member (A) secure to the door (P) and a rest position in which it allows the said member (A) to disengage from the door (P) to be opened. An electromechanical control device (7) includes a bimetal strip (8) with an associated heating element (12). The strip is coupled to a locking member (13) movable, as a result of heating of the strip (8), from a rest position to an obstruction position in which it prevents the cursor (4) from passing from its working to its rest position. An unlocking member (15) is associated with the locking member (13) and includes a control member (16) mounted on the casing (2) for movement between a rest position in which the locking member (13) is allowed to move and a working position in which it acts to force the locking member (13) to move from its obstruction position to its release position. An electrically-controlled actuator (19) is associated with the said locking member (16) and can be activated to cause the latter to move from its working to its rest position.



## Description

[0001] The present invention relates to a locking device for the door of a domestic electrical appliance.

[0002] More specifically, the subject of the invention is a locking device which includes

a support casing  
a retaining slider, mounted in the casing for movement between a working position in which it acts to retain a clasp member secured to the door, and a rest position in which it allows the said member to disengage and the door to open, and  
an electromechanical control device which includes a bimetal strip with an associated resistive heating element, coupled to a movable locking device, movable, as a result of a heating of the plate, from a rest or release position to a locking position, in which the said locking member is operable to prevent the slider from moving from the working position to the rest position.

[0003] Such devices are currently used for washing machines or washer-dryers.

[0004] Safety regulations demand that the door of a washing machine or washer-dryer cannot be opened in certain conditions, for example when the drum is moving and/or when the level of water in the washing compartment is over a predetermined spill level.

[0005] In order to comply with these regulations, it has become routine to fit doors with locking devices which include electrically controlled actuators, such as solenoids or actuators with thermocouples and heating resistances. Such safety devices prevent the door from opening during a washing cycle and allow it to open at the end of the cycle, but often with a time lag of around 2-3 minutes after the cycle has ended.

[0006] Some devices are made in such a way that if the door is closed when the machine is unplugged, it cannot be opened unless the machine is connected to the electricity supply. Such devices involve problems, for example when demonstrating the machines to the public in showrooms, where domestic appliances on display are not usually connected to the electricity supply.

[0007] In order to overcome this problem, some washing machines have a system for manually unlocking the door, by means, for example, of a release cable accessible in the water intake compartment. This arrangement solves the problem of not being able to open the door with the machine unplugged, for example in a show room, but creates new safety problems since, by operating the release cable, the user could manage to open the door of the machine during a wash cycle.

[0008] The object of the present invention is to provide a locking device for the door of a domestic electrical appliance that allows a user to open the door quickly, that is without having to wait, at any time he may want to, except during an operating cycle during which safety

regulations demand that the door must not be able to be opened.

[0009] This and other objects are achieved according to the invention by providing a locking device, the main characteristics of which are defined in the appended Claim 1.

[0010] Further characteristics and advantages of the invention will become apparent from the detailed description which follows, provided purely by way of non-limitative example, with reference to the appended drawings, in which:

Figure 1 is a partially sectioned view of a locking device of the invention, shown in the rest position, with the associated door open;

Figure 2 is a partially sectioned view of the locking device of Figure 1, in the same rest condition;

Figure 3 is a sectional view taken on the line III-III of Figure 2;

Figure 4 is a partial perspective view of a braking member associated with a release-control member in a device of the invention;

Figure 5 is a similar view to that of Figure 1 and shows the locking device in the rest condition, with the door of the domestic electrical appliance closed;

Figure 6 is a similar view to that of Figure 2, showing the locking device in the same condition as Figure 5;

Figure 7 is a view of a section taken on the line VII-VII of Figure 6;

Figure 8 is a view on an enlarged scale of a detail indicated VIII in Figure 7;

Figure 9 is a similar view to that of Figure 6, showing the locking device in a different operating condition;

Figure 10 is a view of a section taken on the line X-X of Figure 9;

Figure 11 is a view on an enlarged scale of a detail indicated XI in Figure 10;

Figure 12 is a similar view to that of Figure 5, showing the locking device in the phase of opening the associated door;

Figure 13 is a view in the direction of the arrow XIII of Figure 12, and

Figure 14 is a view of a section taken on the line XIV-XIV of Figure 13.

[0011] In the drawings, a device according to the invention is generally indicated 1. This device includes a support casing 2 for fixing to the structure S (Figure 1) of a domestic electrical appliance, near a loading or access opening O of the machine, which has an associated door P having a hook member A.

[0012] Adjacent the opening O, the structure S of the machine has an aperture Q (Figure 1) for the passage and engagement of the hook member A when the door P is closed (Figure 5). In the embodiment illustrated, the

aperture Q is big enough to allow the member A to be inserted and also to be rotated so as to be disengaged when the door P is opened (Figure 12).

[0013] The casing 2 of the device 1 has an aperture 3 facing the aperture Q (Figure 1) for inserting the hook member A.

[0014] A retaining member or slider 4 is slidably mounted inside the casing 2 of the device, with an aperture or window 5 corresponding substantially with the aperture 3 of the casing.

[0015] The window 5 is engageable by the end of the clasp element A when the door P is closed (Figure 5).

[0016] A spring 6 (Figure 3) is associated with the slider 4 in a manner known per se and tends to urge it into the position shown in Figures 1 and 2.

[0017] As shown in Figure 3, an electromechanical control device 7, of a known type, is arranged inside the casing 2. This device 7 includes a bimetal strip 8, of configuration known per se, with one end securely fixed to the support casing 2 at 9. The other end of the bimetal strip bears a contact 10 facing a contact member 11 fixed to the casing 2.

[0018] A resistive heating element 12, such as a positive-temperature coefficient (PTC) resistor, is associated with the bimetal strip 8 in a known manner.

[0019] The end of the bimetal strip 8 bearing the contact 10 is engaged in a slot in a locking member 13 which is mounted for translation orthogonal to the retaining slider 4, through an aperture 14 in the casing 2 (see the enlarged details shown in Figures 8 and 11).

[0020] According to this arrangement, when the resistor 12 is not supplied with current, and is thus "cold", the bimetal strip 8 assumes the configuration shown in Figure 3, in which it keeps the movable contact 10 separate from the fixed contact 11 and the locking element 13 is in a rest position, withdrawn inside the casing 2.

[0021] When the resistor 12 heats up, as a result of the passage of electricity, the bimetal strip 8 changes configuration, carrying the movable contact 10 into engagement with the contact 11 and tending to push the locking member 13 into an obstruction position in which it partially protrudes out of the casing 2 so as to cooperate functionally with the retaining slider 4 in a way which will be explained in detail later.

[0022] The retaining slider 4 is mounted for movement relative to the support casing 2 between a rest position, shown in Figures 1, 2 and 12, 13, in which it allows the hook member A to engage the window 5 when the door P is closed and to disengage therefrom when the door is opened.

[0023] As shown, for example, in Figure 2, the retaining slider 4 has a lateral projection 4a. When the slider 4 is in its rest position (Figures 1 and 3) the projection 4a contacts the end of the locking member 13.

[0024] The retaining slider 4 is movable into a working position, shown in figures 5 and 6, in which it holds the hook member A in the condition closing the door P. In this position, the projection 4a of the slider 4 uncovers

the locking member 13, as shown most clearly in Figure 6, enabling it to move into the projecting position under the control of the bimetal strip 8, when this latter is heated by the resistor 10 (Figures 9 to 11).

[0025] When the locking member 13 is in its projecting position, it prevents the slider 4 from returning to its rest position from its working position. The door P thus cannot be opened.

[0026] An unlocking device, associated with the locking device 13, is generally indicated 15 in Figure 2.

[0027] The unlocking device 15 includes a rocker 16 pivoted at 17 on the support casing about an axis substantially parallel to the direction of movement of the locking member 13. The rocker 16 has an arm 16a extending near the path of the locking member 13 and an opposite arm 16b.

[0028] The end of the arm 16a of the rocker 16 extends beneath a resilient flap 18 fixed to the support casing. In the embodiment illustrated by way of example, this flap (see Figure 4 in particular) has a plurality of slits 18a giving it the substantial appearance of a comb. During oscillation of the rocker 16, the end of the arm 16a thereof slides against the flap 18 which offers some frictional resistance. The flap 18, which presses on the end of the said arm of the rocker, also helps to ensure that the rocker pivots only about the pivotal axis 17.

[0029] With reference to Figure 2, an electrically-controlled actuator 19 is arranged in the casing 2 near the end of the arm 16b of the rocker 16. In the embodiment illustrated, this actuator includes a solenoid 20 with a movable member 21, constituted at least in part of ferromagnetic material, mounted therein. The movable member 21 has a terminal pin 22 extending near to the end of the arm 16b of the rocker 16.

[0030] In the unexcited condition of the solenoid 20, the movable member 21-22 of the actuator device 19 is in the position shown in Figure 2 and the rocker 16 is positioned whereby the end of the arm 16a does not interfere with the path of movement of the locking device 13. The position of the rocker 16 is stabilised by the resilient flap 18.

[0031] When, as shown in Figure 9, the retaining slider 4 is in its working position and current is passed through the solenoid 20, the movable unit 21-22 translates and the pin 22 exerts a thrust on the end of the arm 16b of the rocker 16, causing it to rotate so that the arm 16a interferes with the locking member 13.

[0032] As shown, for example, in Figure 8, on the side facing the arm 16a of the rocker 16, the top of the locking member 13 is bevelled to form an inclined plane 13a. The end of the arm 16a of the rocker 16 is correspondingly bevelled underneath to form an inclined plane 16c.

[0033] The movable contact 10 carried by the plate 8 and the fixed contact 11 constitute together a switch arranged in series in an electric line supplying the domestic electrical appliance. For convenience, the solenoid 20 of the actuator 19 can be connected to this

electric line, downstream of the switch constituted by the contacts 10 and 11.

[0034] The characteristics of the locking device 1 described above will be better understood from the detailed description which follows of a complete operating cycle thereof.

[0035] When the door P of the machine is open (Figure 1), the retaining cursor 4 is in its rest position (Figures 1 and 2). No current passes through the resistor 12 and the bimetal strip 8 holds the contacts 10 and 11 apart and the locking member 13 in its withdrawn or rest position (Figures 2 and 3). The solenoid 20 is deactivated and the rocker 16 is in the rest position (Figure 2).

[0036] When the door P is closed (Figure 5), the engagement of the hook member A in the window 5 of the retaining cursor 4 causes the latter to move into its working position (Figure 6). The projection 4a of the slider 4 uncovers the locking device 13. However, until the domestic appliance is switched on, the locking device 13 is held in its withdrawn or rest position by the bimetal strip 8, which is still in the configuration shown in Figure 3.

[0037] When the domestic electrical appliance is started, a control unit (not illustrated) thereof causes current to flow to the resistor 12, thereby heating and commutating the bimetal strip 8 which thus changes to the configuration shown in Figure 7. As a result, as seen in Figures 7 and 8, the movable contact 10 is made to engage the fixed contact 11 and the locking member 13 is moved into its partially projecting position in which it prevents the slider 4 from resuming its rest position of Figure 1, by blocking the path of the projection 4a of the said slider 4. In this condition, the door P cannot be opened.

[0038] If current passes through the solenoid 20 of the actuator 19 in this condition, the movable core 21-22 moves into the position shown in Figure 9, causing the rocker 16 to rotate. The end of the arm 16a of the rocker 16 engages the inclined plane 13a of the locking member 13 with its own inclined plane 16a, causing the locking member to return to its withdrawn position (Figures 10 and 11). The solenoid 20 of the actuator device 19 can be activated by a control impulse from the control unit of the domestic appliance, as a result of the user pressing a control button to open the door P. On the other hand, the control unit only activates the said solenoid if the safety conditions for allowing the door P to be opened are fulfilled at that moment.

[0039] Still with reference to Figures 9 to 11, when the rocker 16 rotates as a result of the activation of the actuator 19, the return of the locking member 13 to its withdrawn or inert position also results in opening of the switch constituted by the contacts 10 and 11. As soon as the switch opens, the actuator 19 is almost instantaneously deactivated, and the movable core 21-22 returned to its initial position. The slider 4 is then pushed by the spring 6 and can return to its rest position (Figure 2). While this is happening, the projection 4a of

the slider causes the rocker 16 to return to its initial rest position. Furthermore, the projection 4a of the slider 4 partially overlaps the locking member 13 before this latter is disengaged by the arm 16a of the rocker 16, whereby the cursor 4 is able to continue on its path until it reaches its rest position (Figures 12 to 14). Once it has reached this condition, the hook member A of the door P can be disengaged from the retaining slider 4, and the window Q, and the door P can be opened.

[0040] At this point, the device has resumed its initial condition.

[0041] It will be appreciated that with the device of the invention the door P can be unlocked and opened during operation extremely quickly, without any annoying waiting time.

[0042] It should also be noted that with the device described above it is possible to reopen the door P if the electricity supply is interrupted. In such a case, it is possible to unlock and open the door P as soon as the resistor 12 has cooled sufficiently to allow the bimetal strip 8 to return the locking member 13 to the withdrawn condition in which it is possible to unlock the door.

[0043] The principle of the invention remaining unchanged, it is of course possible to vary embodiments and manufacturing details widely from those described and illustrated here, purely by way of non-limitative example, without departing thereby from the scope of the invention, as defined in the appended Claims.

## Claims

1. A device (1) for locking the door (P) of a domestic appliance, which includes

a support casing (2),  
a retaining slider (4) mounted in the casing (2) for movement between a working position in which it holds a hook member (A) secured to the door (P), and a rest position in which it allows the said hook member (A) to disengage so the door can be opened, and  
an electromechanical control device (7) which includes a bimetal strip (8) with an associated resistive heating element (12) and is coupled to a locking device (13) movable, as a result of the heating of the said strip (8), from a rest or release position into an obstruction position in which it prevents the retaining slider (4) from moving from its working to its rest position; characterised in that it also includes an unlocking device (15) which comprises  
a control member (16) mounted in the casing (2) for movement between a rest position in which it allows the said locking member (13) to move and a working position in which it acts to force the said locking member (13) to move from its obstruction position to its release posi-

tion, and

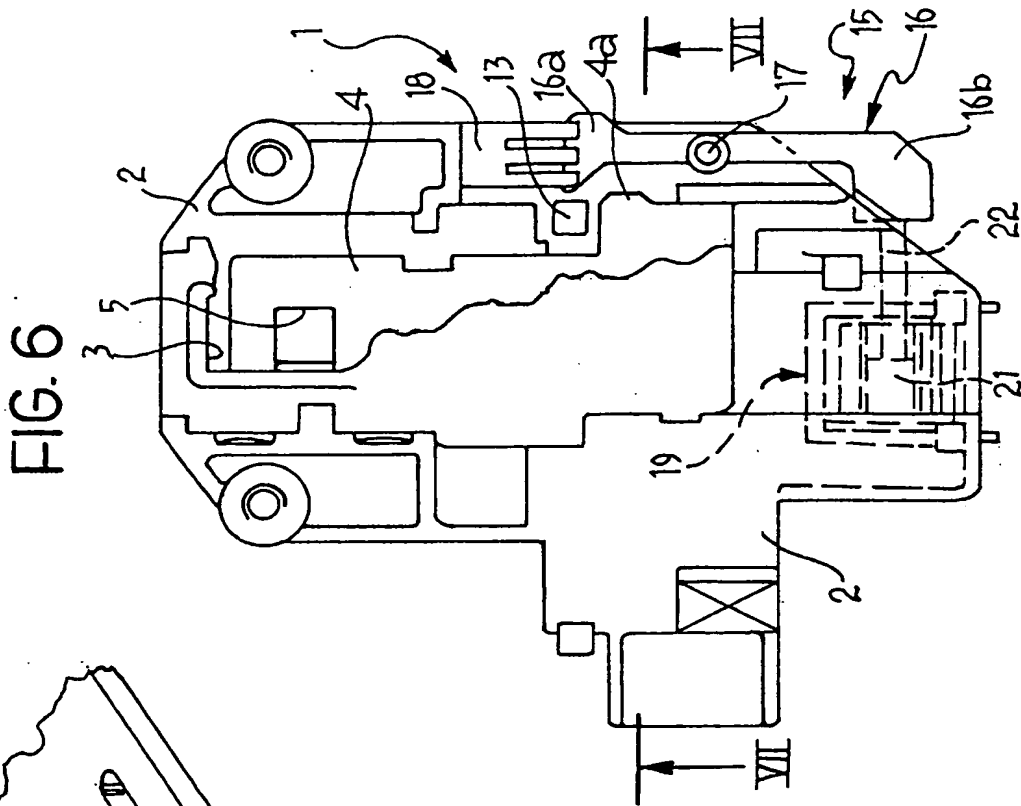
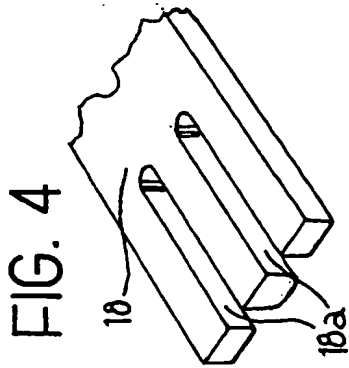
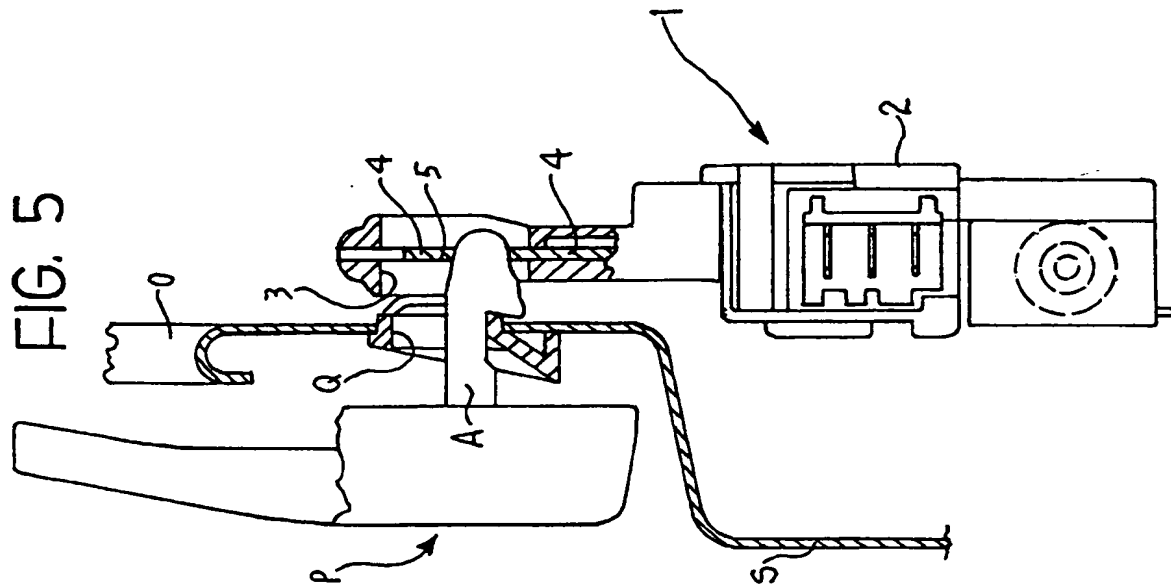
an electrically-controlled actuator (19) associated with the said unlocking device (15) which can be activated to cause the latter to move from its working to its rest position.

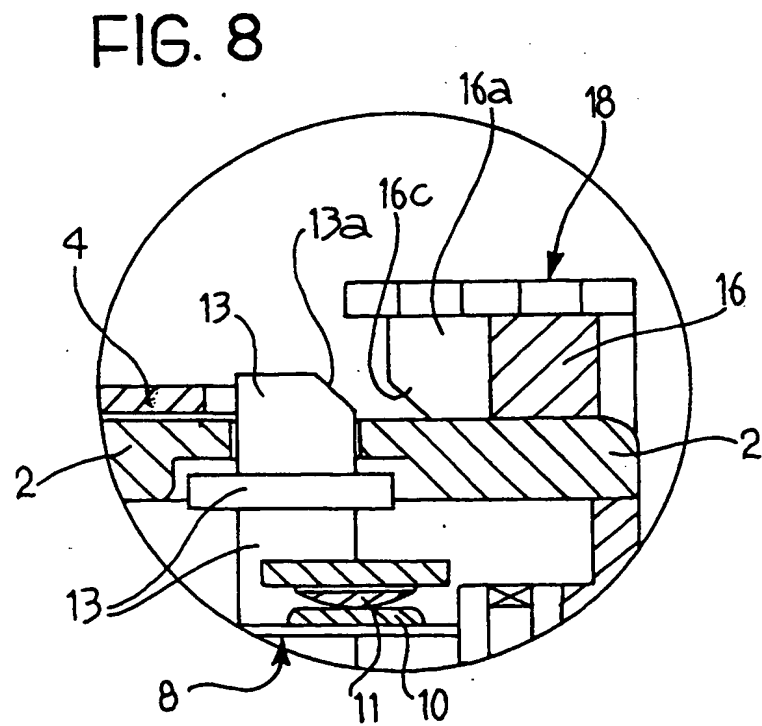
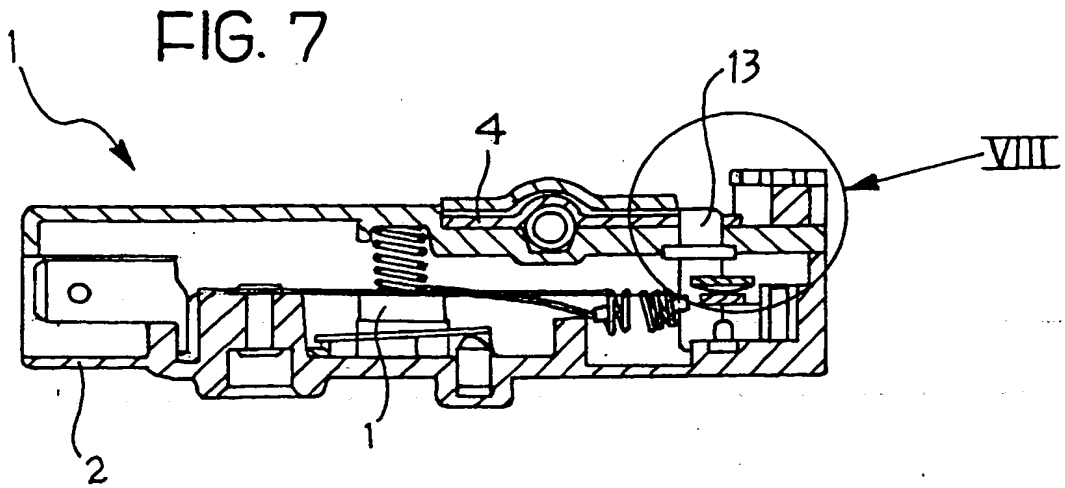
the said contacts (10, 11).

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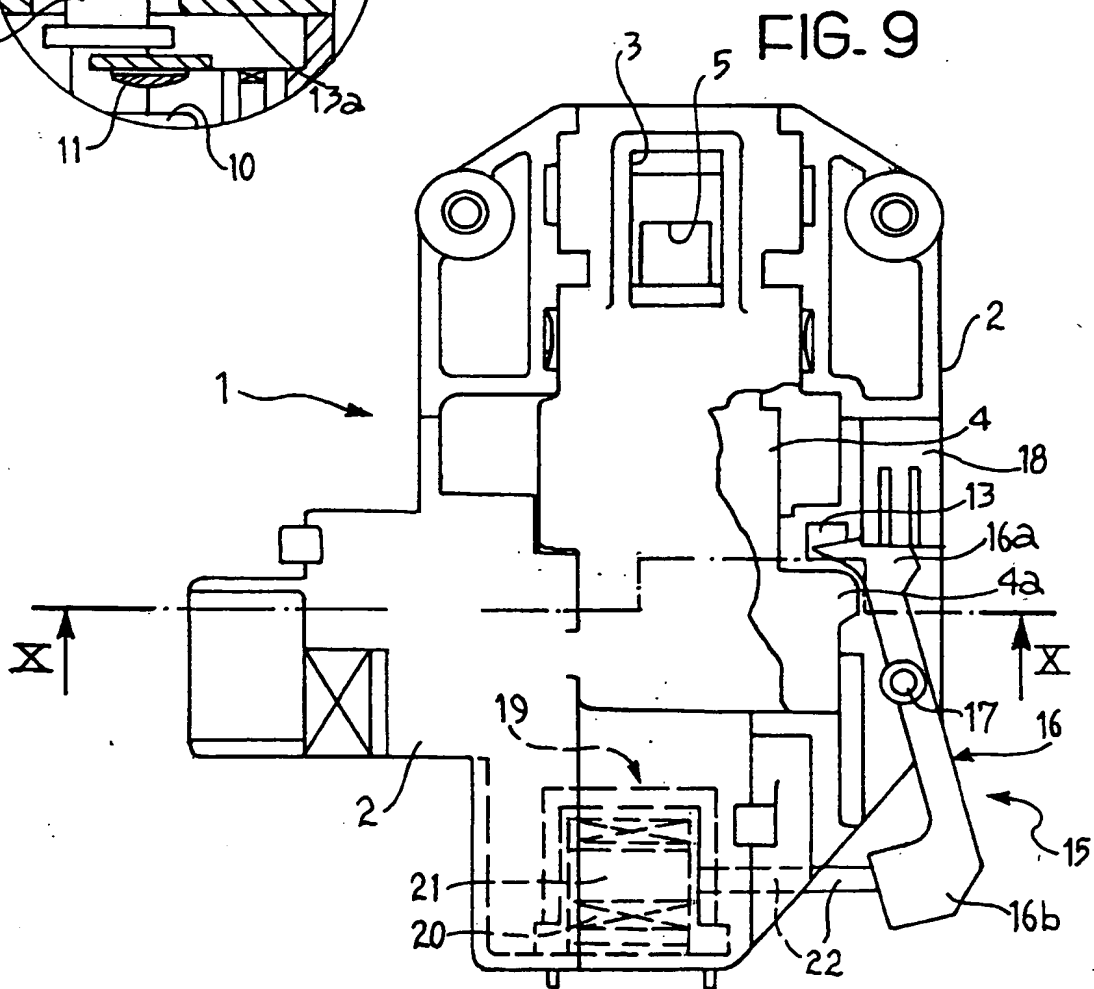
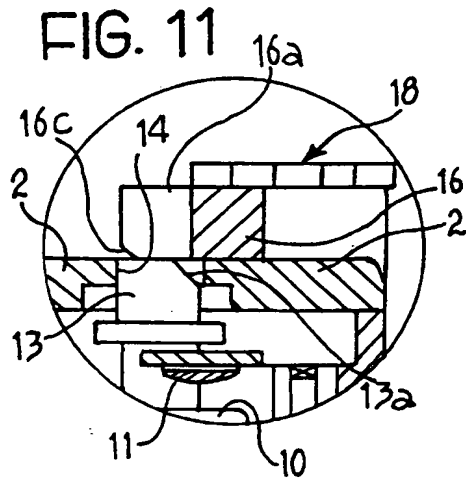
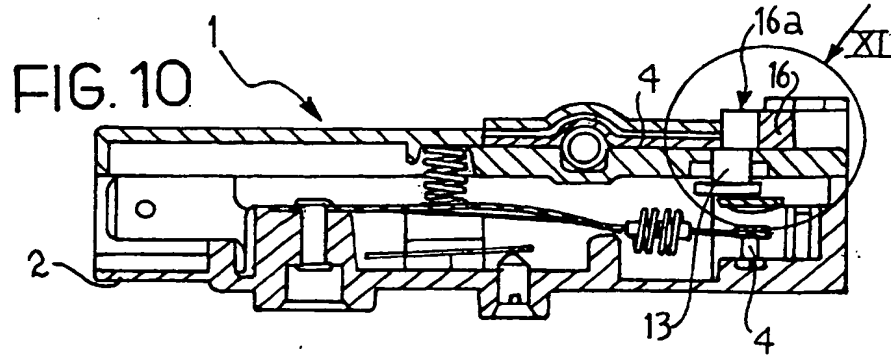
2. A locking device according to Claim 1, characterised in that the said control member (16) is a rocker (16) pivoted to the said support casing (2) about an axis (17) substantially parallel to the direction of movement of the said locking member (13). 10
3. A locking device according to Claim 2, characterised in that an arm (16a) of the said rocker (16) acts to interfere with the locking member (13) when the latter is in its obstruction position, and to cooperate with the said retaining slider (4, 4a) in such a way that the said rocker (16) can be pushed back into its rest position as a result of the movement of the said slider (4) into its rest position, following activation of the unlocking device (15). 15 20
4. A device according to Claim 3, characterised in that a braking member (18) is associated with the said arm (16a) of the rocker (16) for resisting the oscillation thereof. 25
5. A device according to Claim 4, characterised in that the said braking member is a resilient flap (18) fixed to the support casing (2) in such a way that the said arm (16a) of the rocker (16) slides against it. 30
6. A device according to Claim 5, characterised in that the said resilient flap (18) has a plurality of slits (18a) giving it substantially the appearance of a comb. 35
7. A device according to any one of the preceding Claims, characterised in that the cooperating surfaces of the locking member (13) and of the control member (16) have respective planes (13a; 16c) inclined to the plane of movement of the said control member (16). 40
8. A device according to any one of the preceding Claims, characterised in that the said actuator (19) includes a solenoid (20) with an associated movable member (21, 22) for co-operation with the said control member of the unlocking device (15). 45 50
9. A device according to any preceding Claim, in which a movable contact (10) is associated with the said bimetal strip (8) for cooperation with a contact (11) fixed to the casing (2) for closing an electricity supply line only when the locking member (13) is in its said obstruction position; 55  
characterised in that the said solenoid (20) is connected to the said supply line downstream of

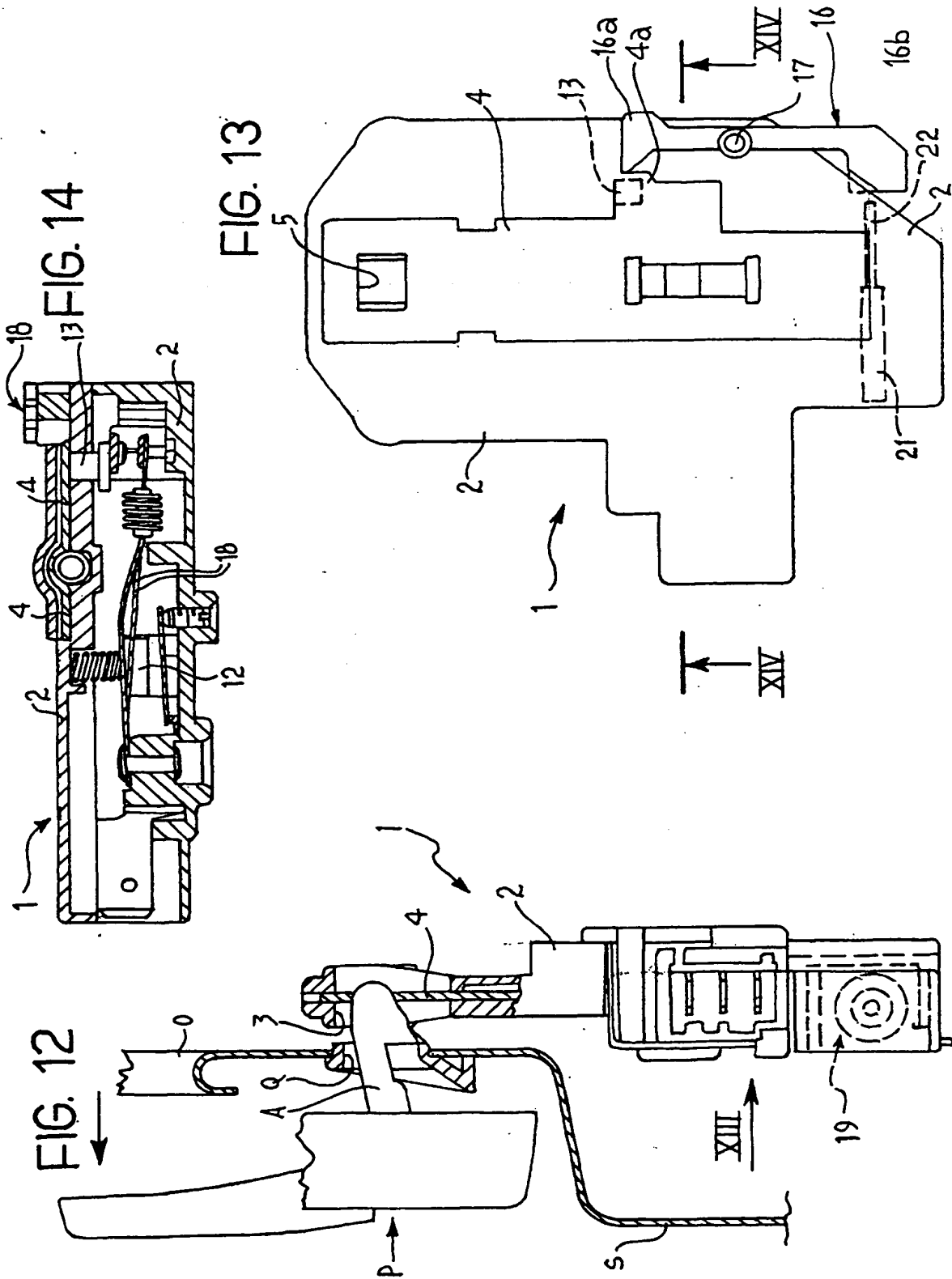














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# EUROPEAN SEARCH REPORT

Application Number  
EP 99 11 1297

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A	GB 2 015 070 A (OMP OFF MECCANO PLAST) 5 September 1979 (1979-09-05) * page 2, line 73 - line 113; figures *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
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The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>11 October 1999</b>	Examiner <b>Debard, M</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 99 11 1297

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